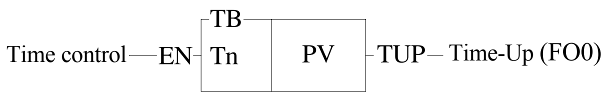
# Chapter 7　Basic Function Instruction

| T | TIMER | T |
|---|---|---|

## Symbol

Ladder symbol



Operand

Tn: Timer Number.
PV: Preset value of the timer.

TB: Time Base (0.01S, 0.1S, 1S)

| Range / Ope-rand | WX | WY | WM | WS | TMR | CTR | HR | IR | OR | SR | ROR | DR | K |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | WX0 \| WX240 | WY0 \| WY240 | WM0 \| WM1896 | WS0 \| WS984 | T0 \| T255 | C0 \| C255 | R0 \| R3839 | R3840 \| R3903 | R3904 \| R3967 | R3968 \| R4167 | R5000 \| R8071 | D0 \| D3071 | 0 \| 32767 |
| Tn | | | | | ○ | | | | | | | | |
| PV | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

● The total number of timers is 256 (T0～T255) with three different time bases, 0.01S, 0.1S and 1S.The default number and allocation of timers is shown as below (Can be adjusted according to user's actual requirements by the "Configuration" function):

T0～T49：0.01S timer（default as 0.00～327.67S）。
T50～T199：0.1S timer（default as 0.0～3276.7S）。
T200～T255：1S timer（default as 0～32767S）。

● FB-PLC programming tool will lookup the timer's time base automatically according to the "Memory Configuration" after the timer number is keyed in. Timer's time = Time base x Preset value. In the example 1 below, the time base T0 = 0.01S and the PV value = 1000, therefore the T0 timer's time = 0.01S x 1000 = 10.00S.

● If PV is a register, then Timer's time = Time base x register content. Therefore, you only need to change the register content to change the timer's time. Please refer to Example 2.

※ The maximum error of a timer is a time base plus a scan time. In order to reduce the timing error in the application, please use the timer with a smaller time base.

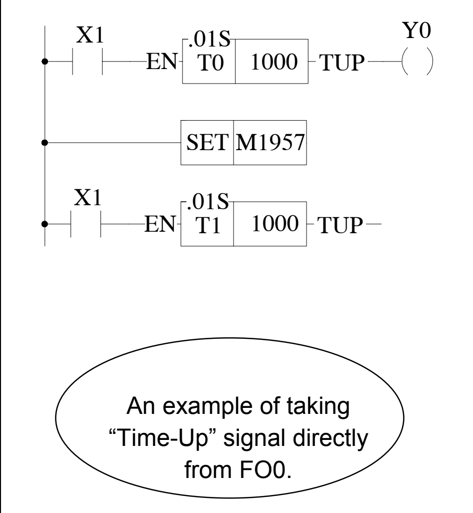
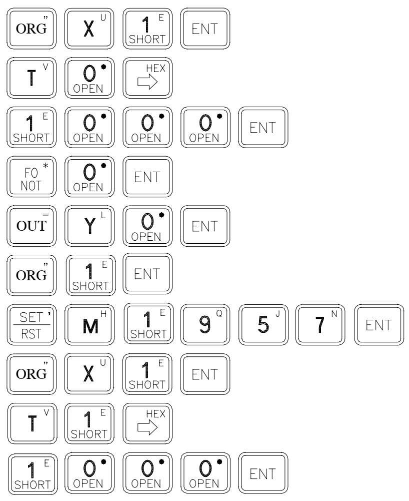
## Description

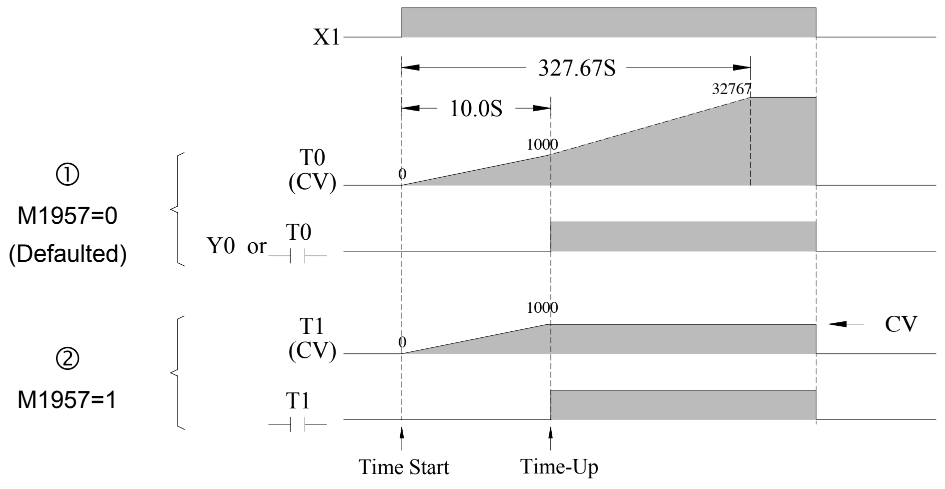
● When the time control "EN" is 1, the timer will start timing (the current value will accumulate from 0) until "Time Up" (i.e. CV≧PV), then the Tn contact and TUP (FO0) will change to 1. As long as the timer control "EN" input is kept as 1, even the CV of Tn has reached or exceeded the PV, the CV of the timer will continue accumulating (with M1957 = 0) until it reaches the maximum limit (32767). The Tn contact status and flag will remain as 1 when CV≧PV, unless the "EN" input is 0. When "EN" input is 0, the CV of Tn will be reset to 0 immediately and the Tn contact and "Time Up" flag TUP will also change to 0 (please refer to the diagram ① below).

● If the FBE/FBN-PLC OS version is higher than V3.0 (inclusive), the M1957 can be set to 1 so the CV will not accumulate further after "Time Up" and stops at the PV value. The default value of the M1957 is 0, therefore the status of M1957 can be set before executing any timer instruction in the program to individually set the timer CV to continue accumulating or stop at the PV after "Time Up" (please refer to the diagram ② below).

| T | TIMER | T |
|---|---|---|

**Example 1** Constant preset value

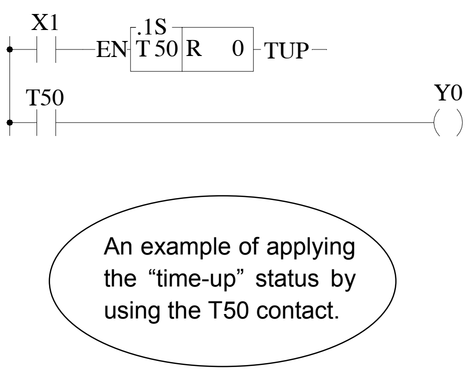
| Ladder diagram | Key operations | Mnemonic code |
|---|---|---|
|   X1<br>.01S<br>EN<br>T0<br>1000<br>TUP<br>Y0<br>SET<br>M1957<br>X1<br>.01S<br>EN<br>T1<br>1000<br>TUP<br>An example of taking "Time-Up" signal directly from FO0. |   ORG X 1 ENT<br>T 0 ⇨<br>1 0 0 0 ENT<br>FO NOT 0 ENT<br>OUT Y 0 ENT<br>ORG 1 ENT<br>SET RST M 1 9 5 7 ENT<br>ORG X 1 ENT<br>T 1 ⇨<br>1 0 0 0 ENT | ORG X 1<br>T0 PV: 1000<br><br>FO 0<br>OUT Y 0<br>ORG SHORT<br>SET M 1957<br>ORG X 1<br>T1 PV: 1000 |

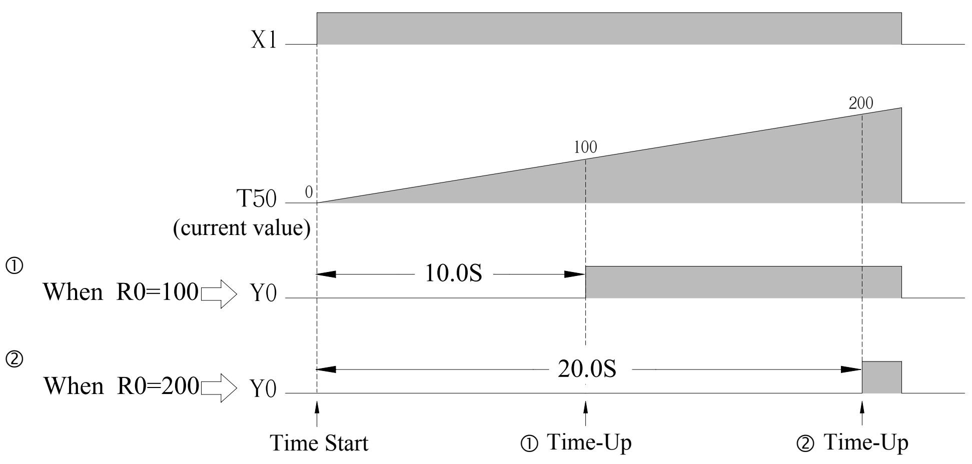


**Example 2** Variable PV

The preset value (PV) shown in example 1 is a constant which is equal to 1000. This value is fixed and can not be changed once programmed. In many circumstances, the preset time of the timers needs to be varied while PLC running. In order to change the preset time of a timer, can first use a register as the PV operand (R or WX, WY...) and then the preset time can be varied by changing the register content. As shown in this example, if set R0 to100, then T becomes a 10S Timer, and hence if set R0 to 200, then T becomes a 20S Timer.

| T | TIMER | T |
|---|---|---|

| Ladder diagram | Key operations | Mnemonic code |
|---|---|---|
|  X1<br>.1S<br>EN<br>T 50<br>R 0<br>TUP<br>T50<br>Y0<br>An example of applying the “time-up” status by using the T50 contact. | ORG X 1 ENT<br>T 5 0 ⇨<br>R 0 ENT<br>ORG T 5 0 ENT<br>OUT Y 0 ENT | ORG X 1<br>T 50 $\boxed{\text{PV:}}$ R 0<br><br>ORG T 50<br>OUT Y 0 |

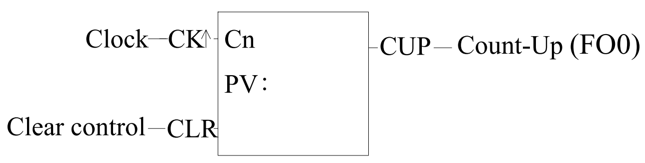


**Remark:** If the preset value of the timer is equal to 0, then the timer's contact status and FO0 (TUP) become 1 ("EN" input must be at 1) immediately after the PLC finishes its first scan because "Time-Up" has occurred. (TUP) stays at 1 until "EN" input changes to 0.

| C | COUNTER<br>（16-Bit: C0～C199，32-Bit: C200～C255） | C |
|---|---|---|

## Symbol

Ladder symbol



Operand

Cn: The Counter number

PV: Preset value

| Range / Ope-rand | WX | WY | WM | WS | TMR | CTR | HR | IR | OR | SR | ROR | DR | K |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | WX0<br>\|<br>WX240 | WY0<br>\|<br>WY240 | WM0<br>\|<br>WM1896 | WS0<br>\|<br>WS984 | T0<br>\|<br>T255 | C0<br>\|<br>C255 | R0<br>\|<br>R3839 | R3840<br>\|<br>R3903 | R3904<br>\|<br>R3967 | R3968<br>\|<br>R4167 | R5000<br>\|<br>R8071 | D0<br>\|<br>D3071 | 0<br>\|<br>2147483647 |
| Cn | | | | | | ○ | | | | | | | |
| PV | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

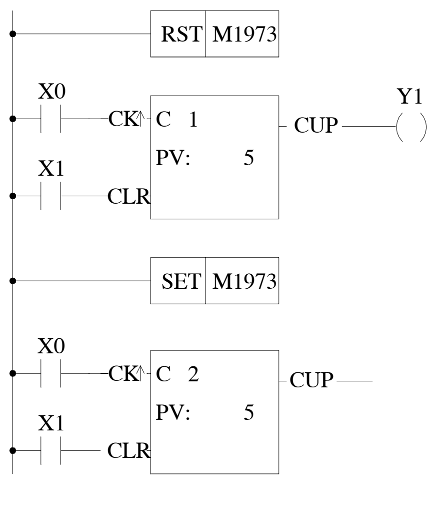
- There are total 200 16-Bit counters (C0~C199). The range of preset value is between 0~32767. C0~C139 are Retentive Counters and the CV value will be retained when the PLC turns on or RUN again after a power failure or a PLC STOP. For Non Retentive Counters, if a power failure or PLC STOP occurs, the CV value will be reset to 0 when the PLC turns on or RUN again.
- There are total 56 32-Bit counters (C200~C255). The range of the preset value is between 0~2147483647. C200~C239 are Retentive Counters and C240~C255 are Non Retentive Counters.
- The default number and assignment of the counters are shown below, if necessary can use the "CONFIGURATION" function to change the settings.
- To insure the proper counting, the sustain time of input status of CLK should greater than 1 scan time.
- The max. counting frequency with this instruction can only up to 20Hz, for higher frequency please use the high-speed soft/hardware counter.

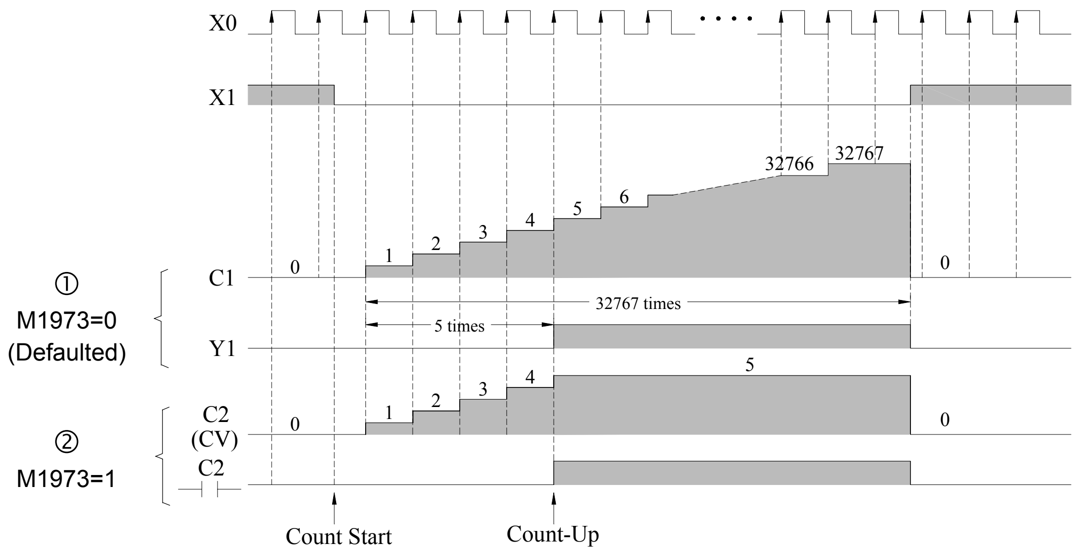
## Description

- When "CLR" is at 1, all of the contact Cn, FO0 (CUP), and CV value of the counter CV are cleared to 0 and the counter stops counting.
- When "CLR" is at 0, the counter is allowed to count up. The Counter counts up every time the clock "CK↑" changes from 0 to 1 (adds 1 to the CV) until the cumulative current value is equal to or greater than the preset value (CV>=PV), the counter "Count-Up" and the contact status of the counter Cn and FO0 (CUP) changes to 1. If the input status of clock continues to change, even the cumulative current value is equal and greater than the preset value, the CV value will still accumulate until it reaches the up limit at 32767 or 2147483647. The contact Cn and FO0 (CUP) stay at 1 as long as CV>=PV unless the "CLR" input is set to 1.（please refer the diagram ① below）。
- If the FBE/FBN-PLC OS version is higher than V3.0 (inclusive), the M1973 can set to 1 so the CV will not accumulate further after “Count Up” and stops at the PV. M1973 default value is 0, therefore the status of M1973 can be set before executing any counter instruction in the program to individually set the counter CV to continue accumulating or stops at the PV after “Count Up” (please refer to the diagram ② below).

| C | COUNTER<br>（16-Bit: C0～C199, 32-bit: C200～C255） | C |
|---|---|---|

**Example 1** 16-Bit Fixed Counter

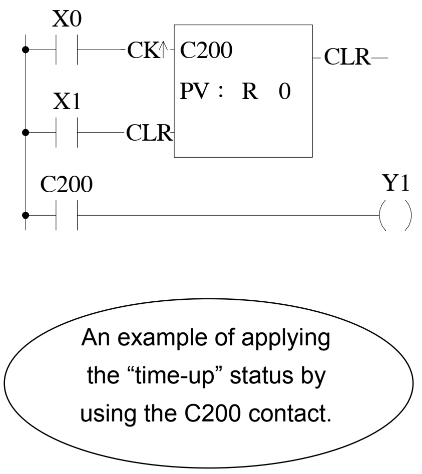
| Ladder diagram | Key operations | Mnemonic code |
|---|---|---|
|  RST M1973<br>X0<br>CK<br>C 1<br>PV: 5<br>CUP<br>Y1<br>X1<br>CLR<br>SET M1973<br>X0<br>CK<br>C 2<br>PV: 5<br>CUP<br>X1<br>CLR | ORG 1 ENT | ORG SHORT |
| | SET/RST SET/RST M 1 9 7 3 ENT | RST M 1973 |
| | ORG X 0 ENT | ORG X 0 |
| | LD X 1 ENT | LD X 1 |
| | C 1 HEX | C 1 PV: 5 |
| | 5 ENT | |
| | FO/NOT 0 ENT | FO 0 |
| | OUT Y 1 ENT | OUT Y 1 |
| | ORG 1 ENT | ORG SHORT |
| | SET/RST M 1 9 7 3 ENT | SET M 1973 |
| | ORG X 0 ENT | ORG X 0 |
| An example of applying the “Count-Up” status by using FO0 directly. | LD X 1 ENT | LD X 1 |
| | C 2 HEX | C 2 PV: 5 |
| | 5 ENT | |

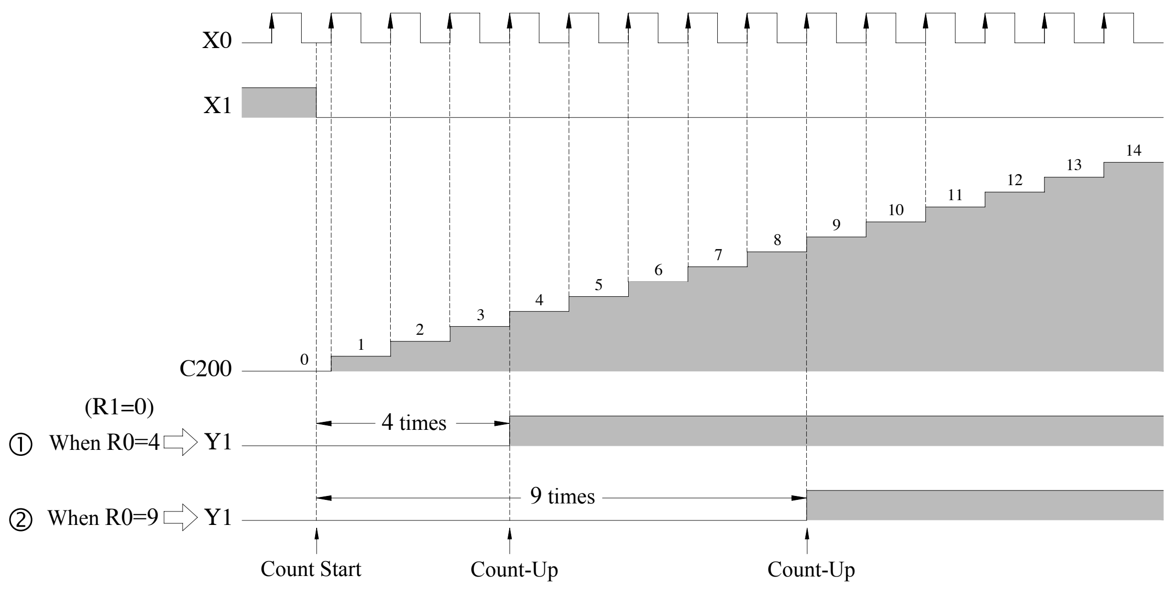


**Example 2** 32-Bit counter with variable preset value

Like a timer, if the PV of a counter is changed to a register (such as R, D, and so on), the counter will use the register contents as the counting PV. Therefore, only need to change the register contents to change the PV of the counter while PLC is running. Below is an example of a 32-bit counter that uses the data register R0 as the PV (in fact it is the 32-bit PV formed by R1 and R0).

| C | COUNTER<br>（16-Bit: C0～C199, 32-Bit: C200～C255） | C |
|---|---|---|

| Ladder diagram | Key operations | Mnemonic code |
|---|---|---|
|  X0<br>CK<br>C200<br>PV : R 0<br>CLR<br>X1<br>CLR<br>C200<br>Y1<br>An example of applying the “time-up” status by using the C200 contact. | ORG X 0 ENT<br>LD X 1 ENT<br>C 2 0 0 ⇨<br>R 0 ENT<br>ORG C 2 0 0 ENT<br>OUT Y 1 ENT | ORG X 0<br>LD X 1<br>C200<br>$\boxed{\text{PV:}}$ R 0<br>ORG C 200<br>OUT Y 1 |

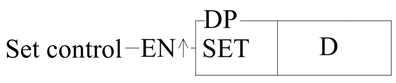


**Remark:** If the preset value of the counter is 0 and "CLR" input also at 0, then the Cn contact status and FO0 (CUP) becomes 1 immediately after the PLC finishes its first scan because the "Count-Up" has occurred. It will stay at 1 regardless how the CV value varies until "CLR" input changes to 1.

| SET **D** **P** | SET<br>(Set coil or all the bits of register to 1) | SET **D** **P** |
|---|---|---|

## Symbol

Ladder symbol



Operand

D: destination to be set
(the number of a coil or a register)

| Range \ Operand | Y | M | SM | S | WY | WM | WS | TMR | CTR | HR | OR | SR | ROR | DR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ope-rand | Y0 \| Y255 | M0 \| M1911 | M1912 \| M2001 | S0 \| S999 | WY0 \| WY240 | WM0 \| WM1896 | WS0 \| WS984 | T0 \| T255 | C0 \| C255 | R0 \| R3839 | R3904 \| R3967 | R3968 \| R4167 | R5000 \| R8071 | D0 \| D3071 |
| D | ○ | ○ | ○* | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○* | ○* | ○ |

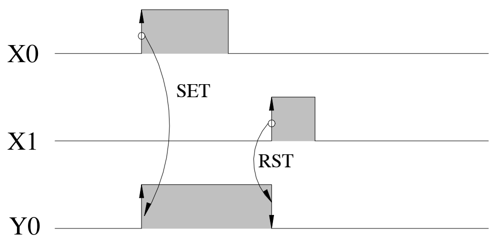
## Description

● When the set control "EN" =1 or "EN↑" (**P** instruction) is from 0 to 1, sets the bit of a coil or all bits of a register to 1.

## Example 1

Single Coil Set

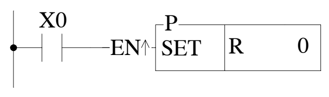
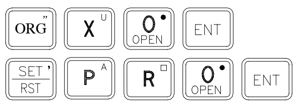
| Ladder Diagram | Key Operations | Mnemonic Codes |
|---|---|---|
| | ORG X 0 ENT<br>SET/RST P Y 0 ENT<br>ORG X 1 ENT<br>SET/RST SET/RST P Y 0 ENT | ORG X 0<br>SET P Y 0<br>ORG X 1<br>RST P Y 0 |



| SET **DP** | SET<br>(Set coil or all the bits of register to 1) | SET **DP** |
|---|---|---|

## Example 2

Set 16-Bit Register

| Ladder Diagram | Key Operations | Mnemonic Codes |
|---|---|---|
|  |  | ORG X 0<br>SET P R 0 |

B15 B0

| D | R0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

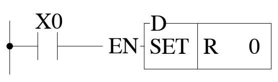
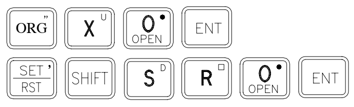
⇩X0＝↑

B15 B0

| D | R0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

## Example 3

32-Bit Register Set

| Ladder Diagram | Key Operations | Mnemonic Codes |
|---|---|---|
|  |  | ORG X 0<br>SET D R 0 |

B31 R1 R0 B0

| D | R0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

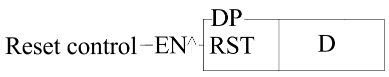
⇩X0＝1

| D | R0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| RST DP | RESET<br>(Reset the coil or the register to 0) | RST DP |
|---|---|---|

## Symbol

Ladder Symbol



Operand

D: Destination to be reset
(the number of a coil or a register)

| Range / Operand | Y | M | SM | S | WY | WM | WS | TMR | CTR | HR | OR | SR | ROR | DR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Y0<br>\|<br>Y255 | M0<br>\|<br>M1911 | M1912<br>\|<br>M2001 | S0<br>\|<br>S999 | WY0<br>\|<br>WY240 | WM0<br>\|<br>WM1896 | WS0<br>\|<br>WS984 | T0<br>\|<br>T255 | C0<br>\|<br>C255 | R0<br>\|<br>R3839 | R3904<br>\|<br>R3967 | R3968<br>\|<br>R4167 | R5000<br>\|<br>R8071 | D0<br>\|<br>D3071 |
| D | ○ | ○ | ○* | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○* | ○* | ○ |

## Description

● When the reset control "EN" =1 or "EN ↑ " (P instruction) from 0 to 1, resets the coil or register to 0.

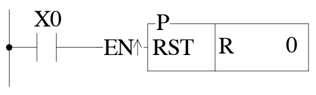
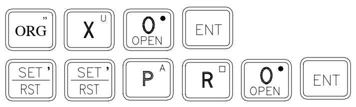
## Example 1

Single Coil Reset

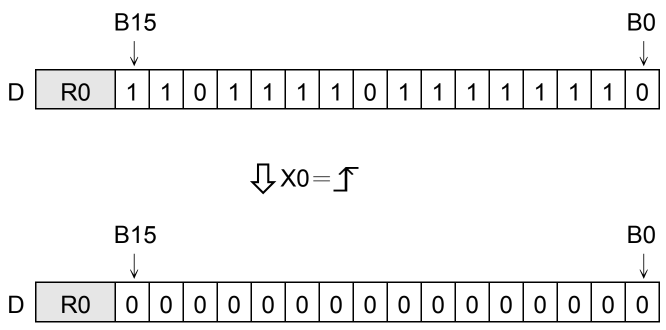
Please refer to example 1 for the SET instruction shown in page 7-8.

## Example 2

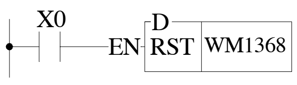
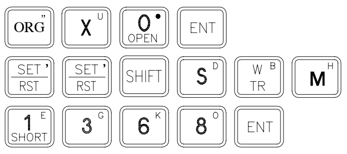
16-Bit Register Reset

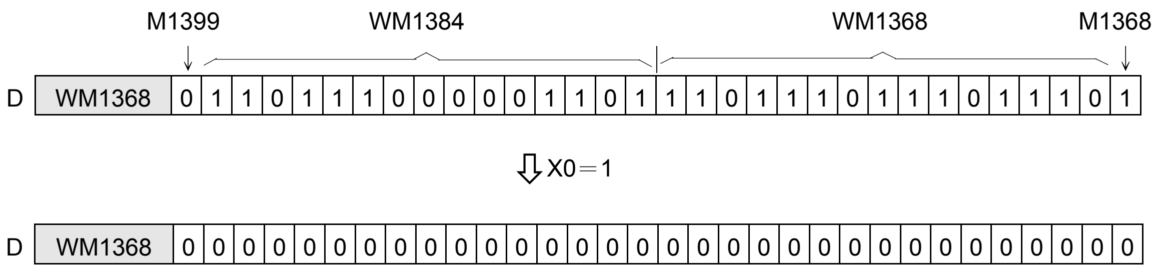
| Ladder Diagram | Key Operations | Mnemonic Codes |
|---|---|---|
|  |  | ORG X 0<br>RST P R 0 |

| RST DP | RESET<br>(Reset the coil or register to 0) | RST DP |
|---|---|---|


B15
B0
D R0 1 1 0 1 1 1 1 0 1 1 1 1 1 1 1 0
X0=
B15
B0
D R0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

| Example 3 | 32-Bit Register Reset |
|---|---|

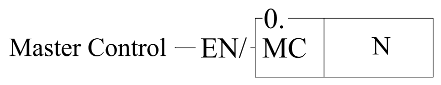
| Ladder Diagram | Key Operations | Mnemonic Codes |
|---|---|---|
|  |   ORG X 0 ENT<br>SET RST SET RST SHIFT S W TR M<br>1 SHORT 3 6 8 ENT | ORG X 0<br>RST D WM1368 |


M1399
WM1384
WM1368
M1368
D WM1368 0 1 1 0 1 1 1 0 0 0 0 0 1 1 0 1 1 1 0 1 1 1 0 1 1 1 0 1 1 1 0 1
X0=1
D WM1368 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

| FUN 0<br>MC | MATER CONTROL LOOP START | FUN 0<br>MC |
|---|---|---|

## Symbol

Ladder Symbol



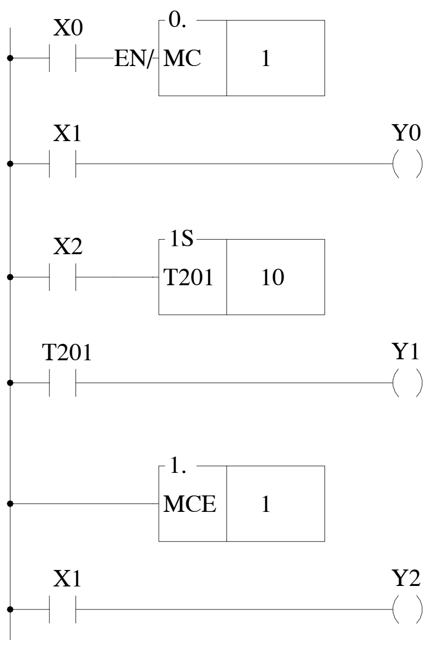
Operand

N: Master Control Loop number (N=0~127) the number N cannot be used repeatedly.

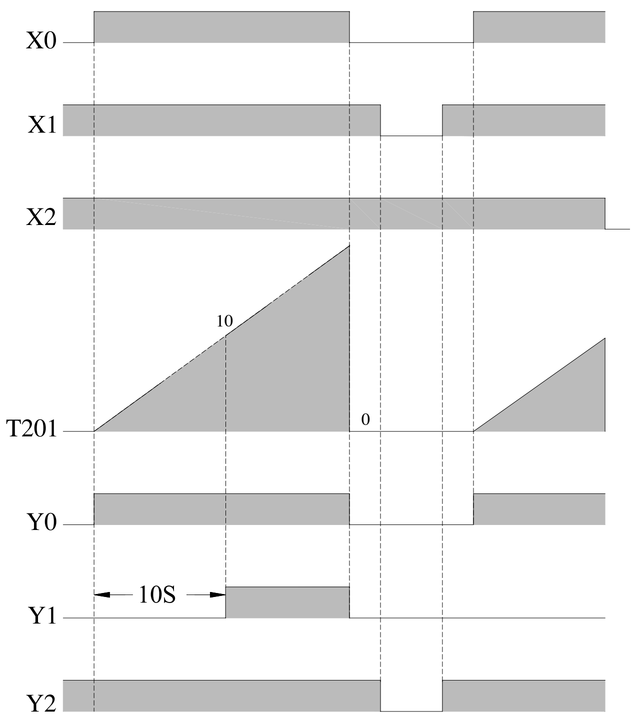
## Description

- There are a total of 128 MC loops (N=0~127). Every Master Control Start instruction, MC N, must correspond to a Master Control End instruction, MCE N, which has the same loop number as MC N. They must always be used in pairs and you should also make sure that the MCE N instruction is after the MC N instruction.
- When the Master Control input "EN/" is 1, then this MC N instruction will not be executed, as it does not exist.
- When the Master Control input "EN/" is 0, the master control loop is active, the area between the MC N and MCE N is called the Master Control active loop area. All the status of OUT coils or Timers within Master Control active loop area will be cleared to 0. Other instructions will not be executed.

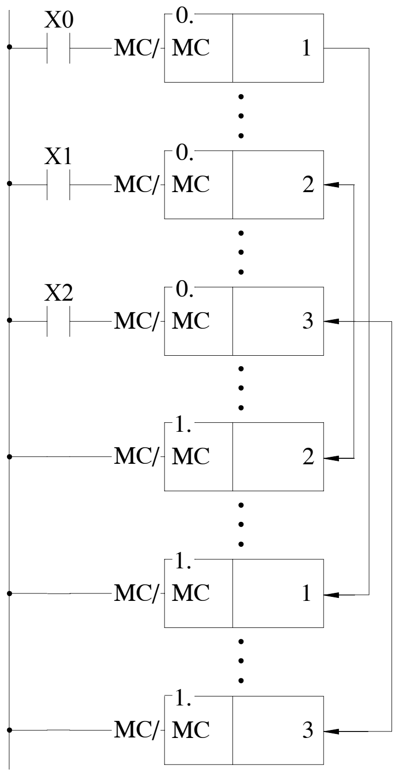
## Example

| Ladder Diagram | Key Operations | Mnemonic Codes |
|---|---|---|
|  X0<br>0.<br>EN/<br>MC<br>1<br>X1<br>Y0<br>X2<br>1S<br>T201<br>10<br>T201<br>Y1<br>1.<br>MCE<br>1<br>X1<br>Y2 | ORG X 0 ENT<br>FUN 0 ENT<br>1 ENT<br>ORG X 1 ENT<br>OUT Y 0 ENT<br>ORG X 2 ENT<br>T 2 0 1 HEX<br>1 0 ENT<br>ORG T 2 0 1 ENT<br>OUT Y 1 ENT<br>FUN 1 ENT<br>1 ENT<br>ORG X 1 ENT<br>OUT Y 2 ENT | ORG X 0<br>FUN 0<br>N : 1<br>ORG X 1<br>OUT Y 0<br>ORG X 2<br>T201 PV : 10<br>ORG T 201<br>OUT Y 1<br>FUN 1<br>N : 1<br>ORG X 1<br>OUT Y 2 |

| FUN 0<br>MC | MATER CONTROL LOOP START | FUN 0<br>MC |
|---|---|---|



Remark1:MC/MCE instructions can be used in nesting or interleaving as shown to the right:



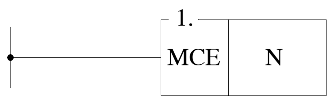
Remark2: • When M1918=0 and the master input changes from 0→1, and if pulse type function instructions exist in the master control loop, then these instructions will have a chance to be executed only once (when the first time the master control input changes from 0→1). Afterwards, no matter how many times the master control input changes from 0→1, the pulse type function instructions will not be executed again.

- When M1918=1 and the master control input changes from 0→1, and if pulse type function instructions exist in the master control loop, then each time the master control input changes from 0→1 the pulse type function instructions in the master control loop will be executed as long as the action conditions are satisfied.
- When a counting instruction exists in the master control loop, set M1918 to 0 can avoid counting error.
- When the pulse type function instructions in the master control loop must act upon the 0→1 input change by the master control, the flag M1918 should be set to 1.

| FUN 1<br>MCE | MASTER CONTROL LOOP END | FUN 1<br>MCE |
|---|---|---|

**Symbol**

Ladder Symbol



Operand

N: Master Control End number (N=0~127) N can not be used repeatedly.

**Description**

- Every MCE N must correspond to a Master Control Start instruction. They must always be used as a pair and you should also make sure that the MCE N instruction is after the MC N instruction. After the MC N instruction has been executed, all output coil status and timers will be cleared to 0 and no other instructions will be executed. The program execution will resume until a MCE instruction which has the same N number as MC N instruction appears.

- MCE instruction does not require an input control because the instruction itself forms a network which other instructions can not connect to it. If the MC instruction has been executed then the master control operation will be completed when the execution of the program reaches the MCE instruction. If MC N instruction has never been executed then the MCE instruction will do nothing.

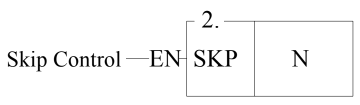
**Description**

- Please refer to the example and explanations for MC instruction.

| FUN 2<br>SKP | SKIP START | FUN 2<br>SKP |
|---|---|---|

## Symbol

Ladder Symbol



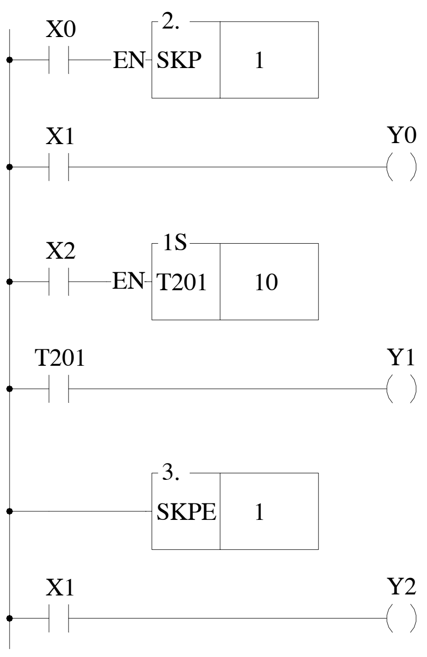
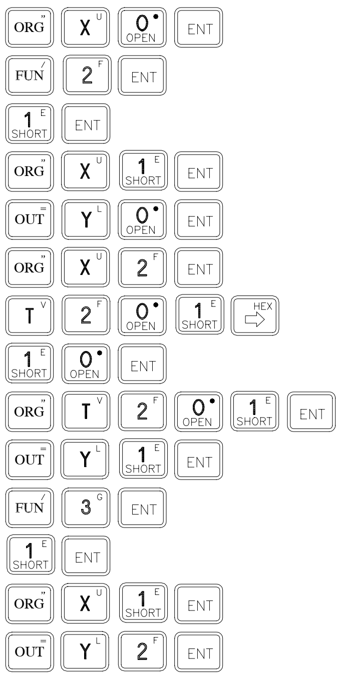
Operand

N: Skip loop number (N=0~127),
N can not be used repeatedly.

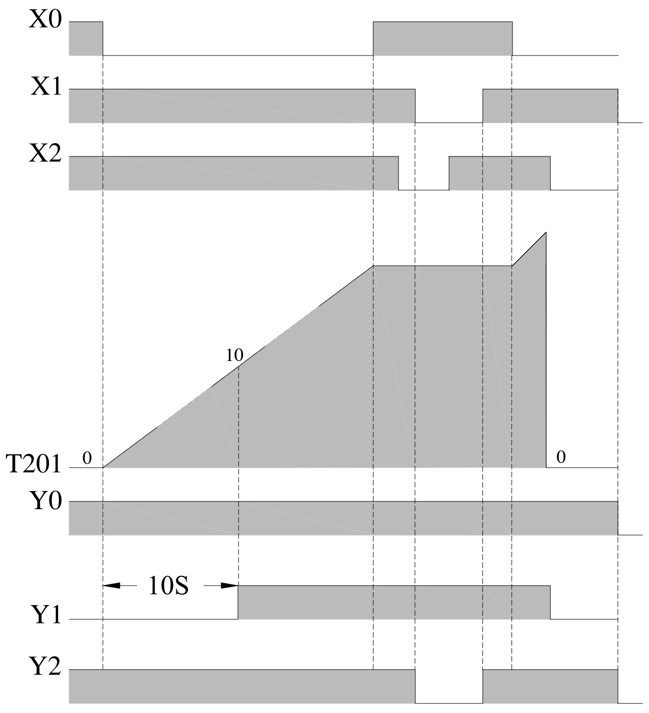
## Description

- There are total 128 SKP loops (N=0~127). Every skip start instruction, SKP N, must correspond to a skip end instruction, SKPE N, which has the same loop number as SKP N. They must always be used as a pair and you should also make sure that the SKPE N instruction is after the SKP N instruction.
- When the skip control "EN" is 0, then the Skip Start instruction will not be executed.
- When the skip control "EN" is 1, the range between the SKP N and SKPE N which is so called the Skip active loop area will be skipped, that is all the instructions in this area will not be executed. Therefore the statuses of the discrete or registers in this Skip active loop area will be retained.

## Example

| Ladder Diagram | Key Operations | Mnemonic Codes |
|---|---|---|
|  X0<br>2.<br>EN<br>SKP<br>1<br>X1<br>Y0<br>X2<br>1S<br>EN<br>T201<br>10<br>T201<br>Y1<br>3.<br>SKPE<br>1<br>X1<br>Y2 |  ORG X 0 ENT<br>FUN 2 ENT<br>1 ENT<br>ORG X 1 ENT<br>OUT Y 0 ENT<br>ORG X 2 ENT<br>T 2 0 1 HEX<br>1 0 ENT<br>ORG T 2 0 1 ENT<br>OUT Y 1 ENT<br>FUN 3 ENT<br>1 ENT<br>ORG X 1 ENT<br>OUT Y 2 ENT | ORG X 0<br>FUN 2<br>N : 1<br>ORG X 1<br>OUT Y 0<br>ORG X 2<br>T201 PV : 10<br>ORG T 201<br>OUT Y 1<br>FUN 3<br>N : 1<br>ORG X 1<br>OUT Y 2 |

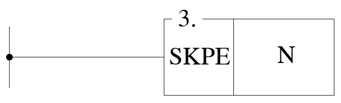
| FUN 2<br>SKP | SKIP START | FUN 2<br>SKP |
|---|---|---|



| FUN 3<br>SKPE | SKIP END | FUN 3<br>SKPE |
|---|---|---|

## Symbol

Ladder Symbol



Operand

N : SKIP END Loop number (N=0~127) N can not be used repeatedly.

## Description

- Every SKPE N must correspond to a SKP N instruction. They must always be used as a pair and you should also make sure that the SKPE N instruction is behind the SKP N instruction.
- SKPE instruction does not require an input control because the instruction itself forms a network which other instructions can not connect to it. If the SKP N instruction has been executed then the skip operation will be completed when the execution of the program reaches the SKPE N instruction. If SKP N instruction has never been executed then the SKPE instruction will do nothing.

## Example

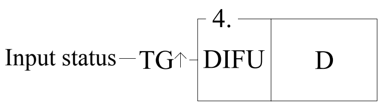
- Please refer to the example and explanations for SKP N instruction.

**Remark :** SKP/SKPE instructions can be used by nesting or interleaving. The coding rules are the same as for the MC/MCE instructions. Please refer to the section of MC/MCE instructions.

| FUN 4 DIFU | DIFFERENTIAL UP | FUN 4 DIFU |
|---|---|---|

## Symbol

Ladder Symbol



Operand

D: a specific coil number where the result of the Differential Up operation is stored.

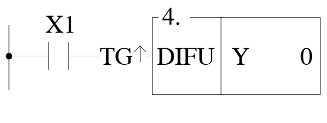
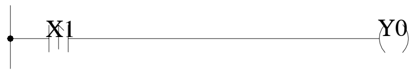
| Range / Operand | Y | M | SM | S |
|---|---|---|---|---|
| | Y0 \| Y255 | M0 \| M1911 | M1912 \| M2001 | S0 \| S999 |
| D | ○ | ○ | ○* | ○ |

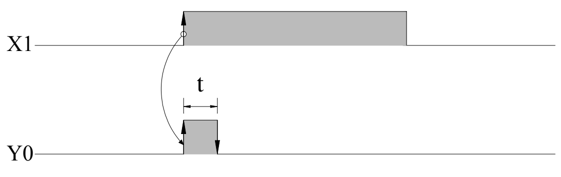
## Description

- The DIFU instruction is used to output the up differentiation of a node status (status input to "TG ↑ ") and the pulse signal resulting from the status change at the rising edge of the "TG ↑ " for one scan time is stored to a coil specified by D.
- The functionality of this instruction can also be achieved by using a TU contact.

## Example

The results of the following two samples are exactly the same

| Ladder Diagram | Key Operations | Mnemonic Codes |
|---|---|---|
| Example 1  | ORG X 1 ENT<br>FUN 4 ENT<br>Y 0 ENT | ORG X 1<br>FUN 4<br>D : Y 0 |
| Example 2  | ORG TU X 1 ENT<br>OUT Y 0 ENT | ORG TU X 1<br>OUT Y 0 |

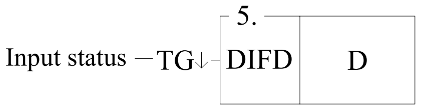


t: scan time

| FUN 5 DIFD | DIFFERENTIAL DOWN | FUN 5 DIFD |
|---|---|---|

## Symbol

Ladder Symbol



Operand

N: a specific coil number where the result of the Differential Down operation is stored.

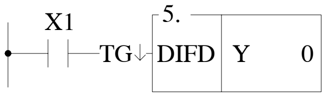
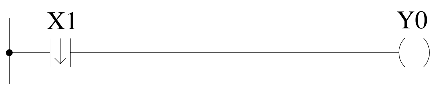
| Range / Operand | Y | M | SM | S |
|---|---|---|---|---|
| | Y0 ∣ Y255 | M0 ∣ M1911 | M1912 ∣ M2001 | S0 ∣ S999 |
| D | ○ | ○ | ○* | ○ |

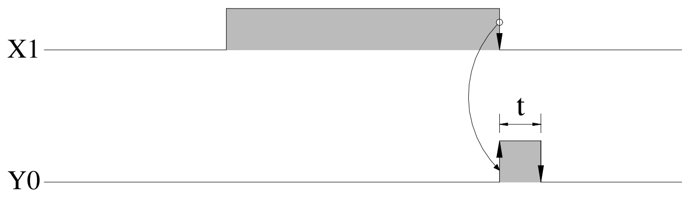
## Description

- The DIFD instruction is used to output the down differentiation of a node status (status input to "TG ↓ ") and the pulse signal resulting from the status change at the falling edge of the "TG ↓ " for one scan time is stored to a coil specified by D.
- The functionality of this instruction can also be achieved by using a TD contact.

## Example

The results of the following two samples are exactly the same

| Ladder Diagram | Key Operations | Mnemonic Codes |
|---|---|---|
| Example 1  | ORG X 1 ENT<br>FUN 5 ENT<br>Y 0 ENT | ORG X 1<br>FUN 5<br>D : Y 0 |
| Example 2  | ORG TD TD X 1 ENT<br>OUT Y 0 ENT | ORG TD X 1<br>OUT Y 0 |

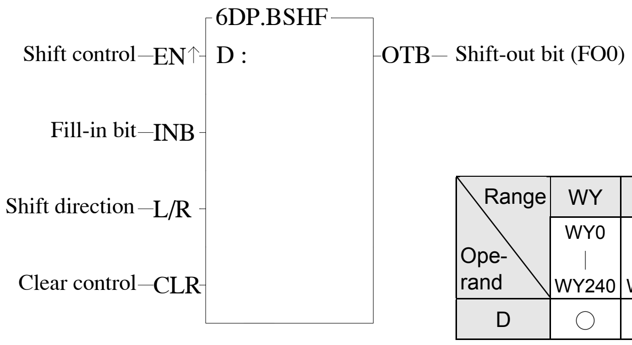


t: scan time

| FUN 6 D P BSHF | BIT SHIFT (Shifts the data of the 16-bit or 32-bit register to left or to right by one bit) | FUN 6 D P BSHF |
|---|---|---|

## Symbol

Ladder Symbol



Operand

D: The register number for shifting

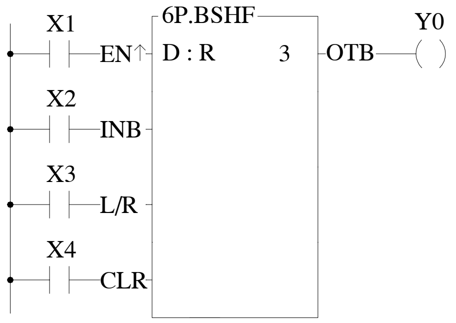
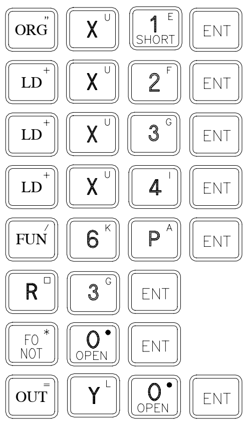
| Range / Operand | WY | WM | | TMR | CTR | HR | OR | SR | ROR | DR |
|---|---|---|---|---|---|---|---|---|---|---|
| | WY0 ∣ WY240 | WM0 ∣ WM1896 | WS0 ∣ WS984 | T0 ∣ T255 | C0 ∣ C255 | R0 ∣ R3839 | R3904 ∣ R3967 | R3968 ∣ R4167 | R5000 ∣ R8071 | D0 ∣ D3071 |
| D | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○* | ○* | ○ |

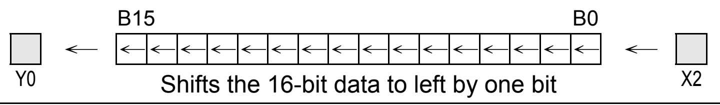
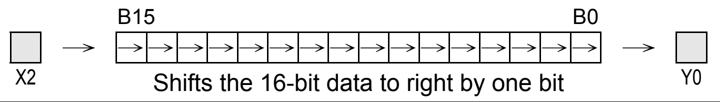
## Description

- When the status of clear control "CLR" is at 1, then the data of register D and FO0 will all be cleared to 0. Other input signals are all in effect.
- When the status of clear control is "CLR" at 0, then the shift operation is permissible. When the shift control "EN" = 1 or "EN ↑ " (P instruction) from 0 to 1, the data of the register will be shifted to right (L/R=0) or to left (L/R=1) by one bit. The shifted-out bit (MSB when shift to left and LSB when shift to right) for both cases will be sent to FO0. The vacated bit space (LSB when shift to left and MSB when shift to right) due to shift operation will be filled in by the input status of fill-in bit "INB".

## Example

Shifts the 16-bit register data

| Ladder diagram | Key Operations | Mnemonic Codes |
|---|---|---|
|  |  | ORG X 1<br>LD X 2<br>LD X 3<br>LD X 4<br>FUN 6P<br>D : R 3<br>FO 0<br>OUT Y 0 |

| | |
|---|---|
| X3=1 (Left shift) |  |
| X3=0 (Right shift) |  |

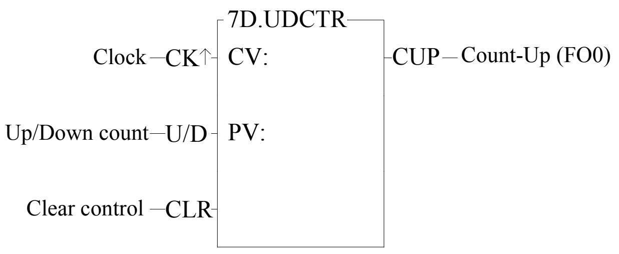
B15
B0
Y0
X2
Shifts the 16-bit data to left by one bit

B15
B0
X2
Y0
Shifts the 16-bit data to right by one bit

| FUN 7 **D** UDCTR | UP/DOWN COUNTER (16-bit or 32-bit up and down 2-phase Counter) | FUN 7 **D** UDCTR |
|---|---|---|

## Symbol

Ladder Symbol



Operand

CV: The number of the Up/Down Counter
PV: Preset value of the counter or it's register number

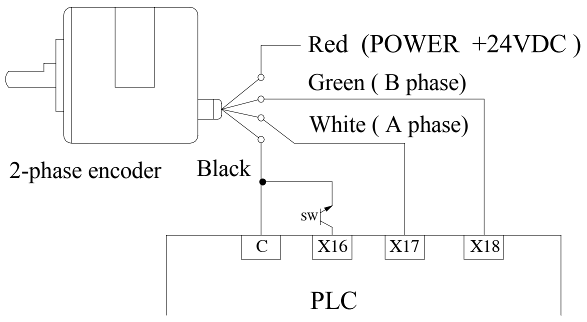
| Range / Ope-rand | WX | WY | WM | WS | TMR | CTR | HR | IR | OR | SR | ROR | DR | K |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | WX0 \| WX240 | WY0 \| WY240 | WM0 \| WM1896 | WS0 \| WS984 | T0 \| T255 | C0 \| C255 | R0 \| R3839 | R3840 \| R3903 | R3904 \| R3967 | R3968 \| R4167 | R5000 \| R8071 | D0 \| D3071 | 16/32-bit +/– number |
| CV | | ○ | ○ | ○ | ○ | ○ | ○ | | ○ | ○* | ○* | ○ | |
| PV | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

## Description

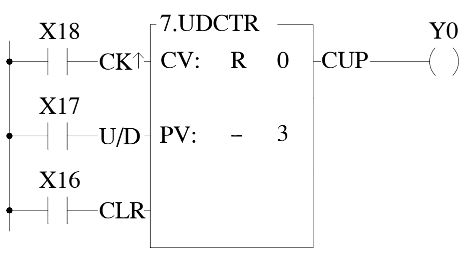
- When the clear control "CLR" is 1, the counter's CV will be reset to 0 and the counter will not be able to count.
- When the clear control "CLR" is 0, counting will then be allowed. The nature of the instruction is a P instruction. Therefore, when the clock "CK↑" is 0→1 (rising edge), the CV will increased by 1 (if U/D=1) or decreased by 1 (if U/D=0).
- When CV=PV, FO0("Count-Up) will change to 1". If there are more clocks input, the counter will continue counting which cause CV≠PV. Then, FO0 will immediately change to 0. This means the "Count-Up" signal will only be equal to 1 if CV=PV, or else it will be equal to 0 (Care should be taken to this difference from the "Count-Up" signal of the general counter).
- The upper limit of up count value is 32767 (16-bit) or 2147483647 (32-bit). After the upper limit is reached, if another up count clock is received, the counting value will become –32768 or -2147483648 (the lower limit of down count).
- The lower limit of down count value is -32767 (16-bit) or -2147483647 (32-bit). After the lower limit is reached, if another down count clock is received, the counting value will become 32768 or 2147483648 (the upper limit of up count).
- If U/D is fixed as 1, the instruction will become a single-phase up count counter. If U/D is fixed as 0, the instruction will become a single-phase down count counter.

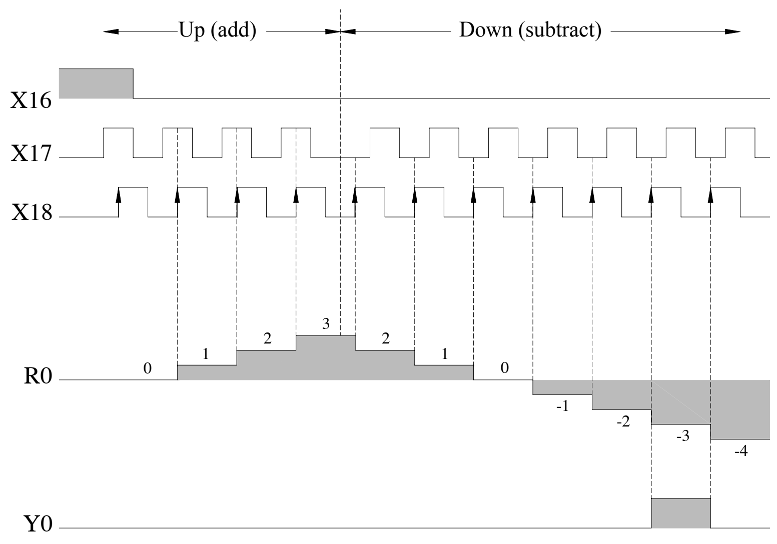
## Example

The diagram below is an application example of UDCTR instruction being applied to an encoder.



| FUN 7 D<br>UDCTR | UP/DOWN COUNTER<br>(16-bit or 32-bit up/down 2-phase Counter) | FUN 7 D<br>UDCTR |
|---|---|---|

| Ladder Diagram | Key Operations | Mnemonic Codes |
|---|---|---|
|  X18<br>X17<br>X16<br>CK↑<br>U/D<br>CLR<br>7.UDCTR<br>CV: R 0<br>PV: – 3<br>CUP<br>Y0 | ORG X 1 8 ENT<br>LD X 1 7 ENT<br>LD X 1 6 ENT<br>FUN 7 ENT<br>R 0 ENT<br>SHIFT OR 3 ENT<br>FO NOT 0 ENT<br>OUT Y 0 ENT | ORG X 18<br>LD X 17<br>LD X 16<br>FUN 7<br>CV : R 0<br>PV : – 3<br>FO 0<br>OUT Y 0 |



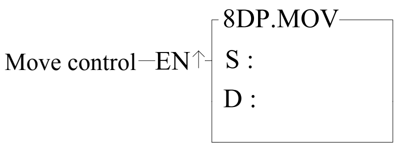
**Remark 1**: Since the counting operation of UDCTR is implemented by software scanning, therefore if the clock speed is faster than the scan speed, lose count may then happen (generally the clock should not exceed 20Hz depending on the size of the program). Please use the software or hardware high-speed counter in the PLC. Refer to the “High Speed Counter Application” in the Advanced Manual.

**Remark 2**: In order to ensure the proper counting, the sustain time of the status of clock input should greater than 1 scan time.

| FUN 8 D P<br>MOV | MOVE<br>(Moves data from S to D) | FUN 8 D P<br>MOV |
|---|---|---|

## Description

Ladder Symbol



Operand

S: Source register number

D: Destination register number

The S, N, D may combine with V, Z to serve indirect addressing

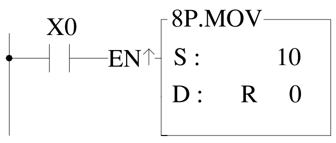
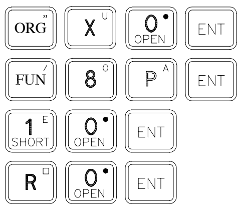
| Range / Ope-rand | WX | WY | WM | WS | TMR | CTR | HR | IR | OR | SR | ROR | DR | K | XR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | WX0 \| WX240 | WY0 \| WY240 | WM0 \| WM1896 | WS0 \| WS984 | T0 \| T255 | C0 \| C255 | R0 \| R3839 | R3840 \| R3903 | R3904 \| R3967 | R3968 \| R4167 | R5000 \| R8071 | D0 \| D3071 | 16/32-bit +/– number | V 、 Z |
| S | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| D | | ○ | ○ | ○ | ○ | ○ | ○ | | ○ | ○* | ○* | ○ | | ○ |

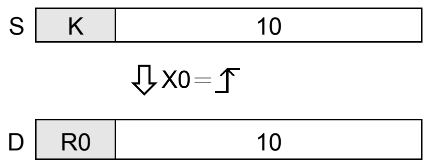
## Description

● Moves (writes) the data of S to a specified register D when the move control input "EN" =1 or "EN↑" (P instruction) from 0 to 1.

## Example

Writes a constant data into a 16-bit register.

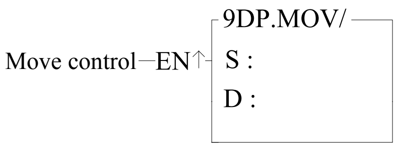
| Ladder Diagram | Key Operations | Mnemonic Codes |
|---|---|---|
|  |  | ORG X 0<br>FUN 8P<br>S : 10<br>D : R 0 |



| FUN 9 **D P**<br>MOV/ | MOVE INVERSE<br>(Inverts the data of S and moves the result to a specified device D) | FUN 9 **D P**<br>MOV/ |
|---|---|---|

## Symbol

Ladder Symbol



Operand

S: Source register number

D: Destination register number

S, N, D may combine with V, Z to serve indirect addressing

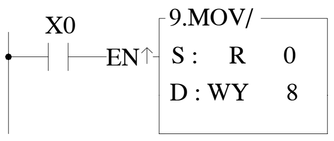
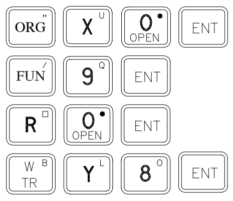
| Range / Ope-rand | WX | WY | WM | WS | TMR | CTR | HR | IR | OR | SR | ROR | DR | K | XR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | WX0<br>│<br>WX240 | WY0<br>│<br>WY240 | WM0<br>│<br>WM1896 | WS0<br>│<br>WS984 | T0<br>│<br>T255 | C0<br>│<br>C255 | R0<br>│<br>R3839 | R3840<br>│<br>R3847 | R3904<br>│<br>R3967 | R3968<br>│<br>R4167 | R5000<br>│<br>R8071 | D0<br>│<br>D3071 | 16/32-bit<br>+/– number | V<br>、<br>Z |
| S | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| D | | ○ | ○ | ○ | ○ | ○ | ○ | | ○ | ○* | ○* | ○ | | ○ |

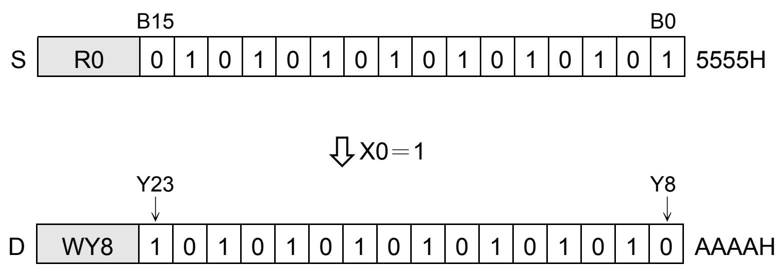
## Description

- Inverts the data of S (changes the status from 0 to 1 and from 1 to 0) and moves the results to a specified register D when the move control input "EN" =1 or "EN ↑ " (**P** instruction) from 0 to1.

## Example

Moves the inverted data of a 16-bit register to another 16-bit register.

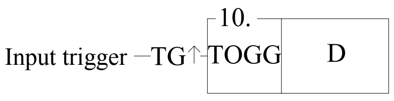
| Ladder Diagram | Key Operations | Mnemonic Codes |
|---|---|---|
|  |  | ORG X 0<br>FUN 9<br>S : R 0<br>D : WY 8 |


B15
B0
S R0 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 5555H
X0＝1
Y23
Y8
D WY8 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 AAAAH

| FUN 10<br>TOGG | TOGGLE SWITCH<br>(Changes the output status when the rising edge of control input occur) | FUN 10<br>TOGG |
|---|---|---|

## Symbol

Ladder Symbol



Operand

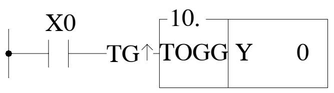
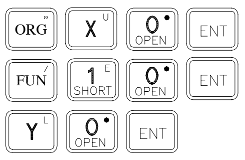
D: the coil number of the toggle switch

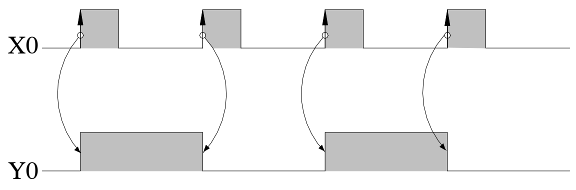
| Range / Operand | Y | M | SM | S |
|---|---|---|---|---|
| | Y0<br>\|<br>Y255 | M0<br>\|<br>M1911 | M1912<br>\|<br>M2001 | S0<br>\|<br>S999 |
| D | ○ | ○ | ○* | ○ |

## Description

- The coil D changes its status (from 1 to 0 and from 0 to 1) each time the input "TG↑" is triggered from 0 to 1 (rising edge).

## Example

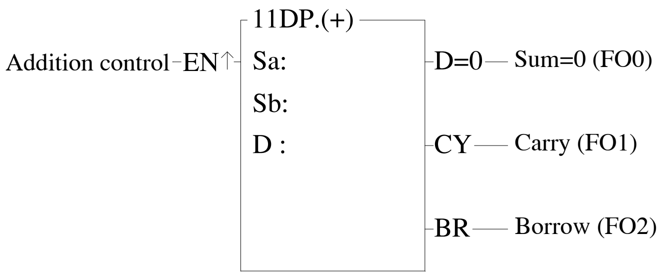
| Ladder Diagram | Key Operations | Mnemonic Codes |
|---|---|---|
|  |  | ORG X 0<br>FUN 10<br>$\boxed{\text{D :}}$ Y 0 |



| FUN 11 **D** **P** (＋) | ADDITION (Performs addition of the data specified at Sa and Sb and stores the result in D) | FUN 11 **D** **P** (＋) |
|---|---|---|

## Symbol

Ladder Symbol



Operand

Sa: Augend

Sb: Addend

D : Destination register to store the results of the addition

S, N, D may combine with V, Z to serve indirect addressing

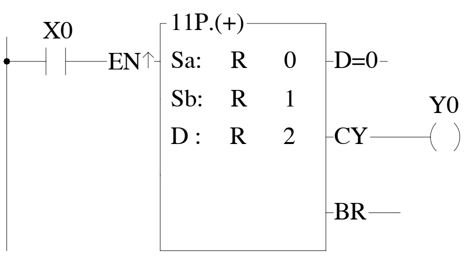
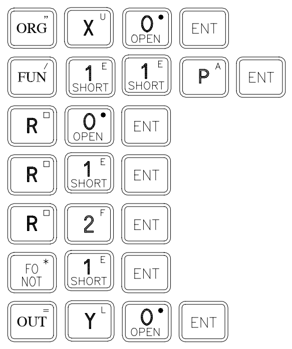
| Range / Ope-rand | WX | WY | WM | WS | TMR | CTR | HR | IR | OR | SR | ROR | DR | K | XR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | WX0 ∣ WX240 | WY0 ∣ WY240 | WM0 ∣ WM1896 | WS0 ∣ WS984 | T0 ∣ T255 | C0 ∣ C255 | R0 ∣ R3839 | R3840 ∣ R3903 | R3904 ∣ R3967 | R3968 ∣ R4167 | R5000 ∣ R8071 | D0 ∣ D3071 | 16/32-bit +/– number | V 、 Z |
| Sa | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Sb | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| D | | ○ | ○ | ○ | ○ | ○ | ○ | | ○ | ○* | ○* | ○ | | ○ |

## Description

● Performs the addition of the data specified at Sa and Sb and writes the results to a specified register D when the add control input "EN" =1 or "EN ↑ " (**P** instruction) from 0 to 1. If the result of addition is equal to 0 then set FO0 to 1. If carry occurs (the result exceeds 32767 or 2147483647) then set FO1 to 1. If borrow occurs (adding negative numbers resulting in a sum less than -32768 or -2147483648), then set the FO2 to 1. All the FO statuses are retained until this instruction is executed again and overwritten by a new result.

## Example

16-bit addition

| Ladder Diagram | Key Operations | Mnemonic Codes |
|---|---|---|
|  |   ORG X 0 ENT; FUN 1 1 P ENT; R 0 ENT; R 1 ENT; R 2 ENT; FO 1 ENT; OUT Y 0 ENT | ORG X 0<br>FUN 11P<br>Sa : R 0<br>Sb : R 1<br>D : R 2<br>FO 1<br>OUT Y 0 |

| | | | |
|---|---|---|---|
| Sa | R0 | 12345 | R0＋R1＝32770 |
| Sb | R1 | 20425 | |

⇩X0＝↑

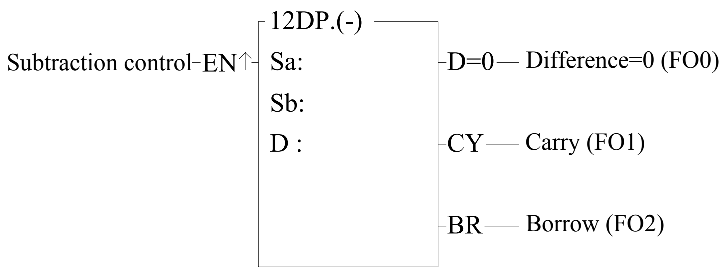
| | | | |
|---|---|---|---|
| D | R2 | 2 | 32768+2=32770 |

Y0＝1 (carry 1 represents ＋32768)

| FUN 12 D P<br>( − ) | SUBTRACTION<br>(Performs subtraction of the data specified at Sa and Sb and stores the result in D) | FUN 12 D P<br>( − ) |
|---|---|---|

## Symbol

Ladder Symbol



Operand

Sa: Minuend
Sb: Subtrahend
D : Destination register to store the results of the subtraction
Sa, Sb, D may combine with V, Z to serve indirect addressing

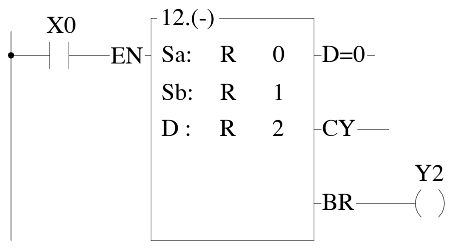
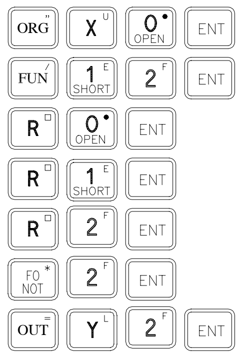
| Range / Operand | WX | WY | WM | WS | TMR | CTR | HR | IR | OR | SR | ROR | DR | K | XR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | WX0 ｜ WX240 | WY0 ｜ WY240 | WM0 ｜ WM1896 | WS0 ｜ WS984 | T0 ｜ T255 | C0 ｜ C255 | R0 ｜ R3839 | R3840 ｜ R3903 | R3904 ｜ R3967 | R3968 ｜ R4167 | R5000 ｜ R8071 | D0 ｜ D3071 | 16/32-bit +/− number | V 、 Z |
| Sa | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Sb | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| D | | ○ | ○ | ○ | ○ | ○ | ○ | | ○ | ○* | ○* | ○ | | ○ |

## Description

- Performs the subtraction of the data specified at Sa and Sb and writes the results to a specified register D when the subtract control input "EN" =1 or "EN ↑ " (P instruction) from 0 to 1. If the result of subtraction is equal to 0 then set FO0 to 1. If carry occurs (subtracting a negative number from a positive number and the result exceeds 32767 or 2147483647), then set FO1 to 1. If borrow occurs (subtracting a positive number from a negative number and the resulted difference is less than -32768 or -2147483648), then set FO2 to 1. All the FO statuses are retained until this instruction is executed again and overwritten by a new result.

## Example

16-bit subtraction

| Ladder Diagram | Key Operations | Mnemonic Codes |
|---|---|---|
|  |  | ORG X 0<br>FUN 12<br>Sa : R 0<br>Sb : R 1<br>D : R 2<br>FO 2<br>OUT Y 2 |

| | | | |
|---|---|---|---|
| Sa | R0 | −5 | R0−R1＝−32772 |
| Sb | R1 | 32767 | |

⇩ X0＝1

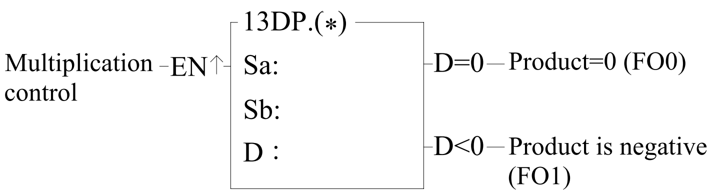
| | | | |
|---|---|---|---|
| D | R2 | −4 | −32768−4＝−32772 |

Y2＝1 ( borrow 1 represents−32768 ) Please refer to section 6.5

| FUN 13 D P (＊) | MULTIPLICATION<br>(Performs multiplication of the data specified at Sa and Sb and stores the result in D) | FUN 13 D P (＊) |
|---|---|---|

## Symbol

Ladder Symbol



Operand

Sa: Multiplicand

Sb: Multiplier

D : Destination register to store the results of the multiplication.

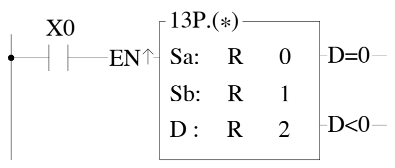
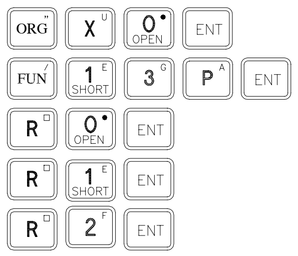
Sa, Sb, D may combine with V, Z to serve indirect addressing

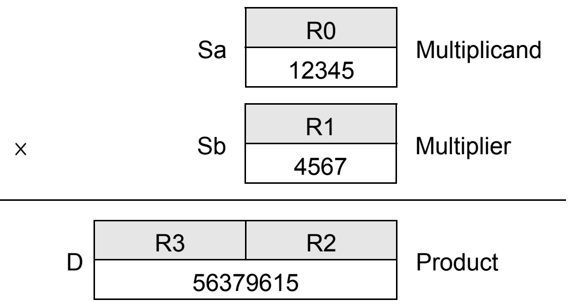
| Range / Operand | WX | WY | WM | WS | TMR | CTR | HR | IR | OR | SR | ROR | DR | K | XR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | WX0<br>\|<br>WX240 | WY0<br>\|<br>WY240 | WM0<br>\|<br>WM1896 | WS0<br>\|<br>WS984 | T0<br>\|<br>T255 | C0<br>\|<br>C255 | R0<br>\|<br>R3839 | R3840<br>\|<br>R3903 | R3904<br>\|<br>R3967 | R3968<br>\|<br>R4167 | R5000<br>\|<br>R8071 | D0<br>\|<br>D3071 | 16/32-bit<br>+/– number | V<br>、<br>Z |
| Sa | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Sb | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| D | | ○ | ○ | ○ | ○ | ○ | ○ | | ○ | ○* | ○* | ○ | | ○ |

## Description

- Performs the multiplication of the data specified at Sa and Sb and writes the results to a specified register D when the multiplication control input "EN" =1 or "EN↑" (P instruction) from 0 to 1. If the product of multiplication is equal to 0 then set FO0 to 1. If the product is a negative number, then set FO1 to 1.

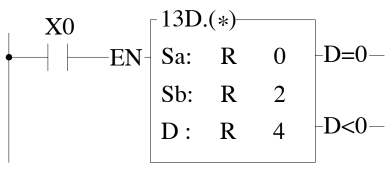
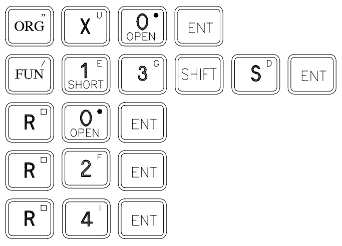
## Example 1 16-bit multiplication

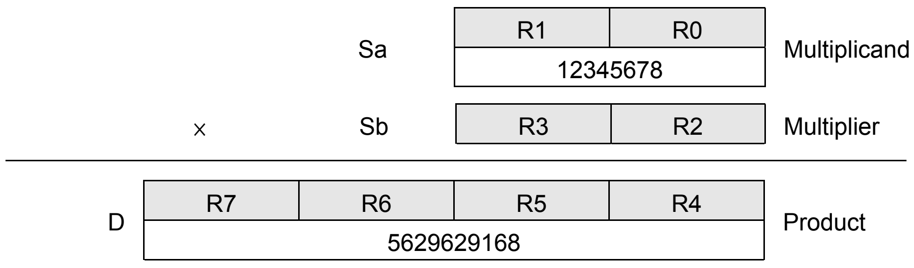
| Ladder Diagram | Key Operations | Mnemonic Codes |
|---|---|---|
|  |  | ORG X 0<br>FUN 13P<br>Sa : R 0<br>Sb : R 1<br>D : R 2 |



| FUN 13 D P (＊) | MULTIPLICATION (Performs multiplication of the data specified at Sa and Sb and stores the result in D) | FUN 13 D P (＊) |
|---|---|---|

**Example 2** 32-bit multiplication

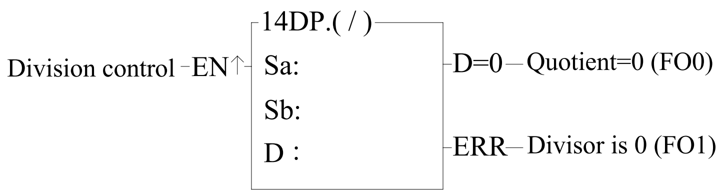
| Ladder Diagram | Key Operations | Mnemonic Codes |
|---|---|---|
|  X0<br>EN<br>13D.(＊)<br>Sa: R 0<br>Sb: R 2<br>D : R 4<br>D=0<br>D<0 |  ORG X 0 ENT<br>FUN 1 3 SHIFT S ENT<br>R 0 ENT<br>R 2 ENT<br>R 4 ENT | ORG X 0<br>FUN 13D<br>Sa : R 0<br>Sb : R 2<br>D : R 4 |



| FUN 14 **D** **P** (／) | DIVISION (Performs division of the data specified at Sa and Sb and stores the result in D) | FUN 14 **D** **P** (／) |
|---|---|---|

## Symbol

Ladder Symbol



Operand

Sa: Dividend

Sb: Divisor

D : Destination register to store the results of the division.

Sa, Sb, D may combine with V, Z to serve indirect addressing

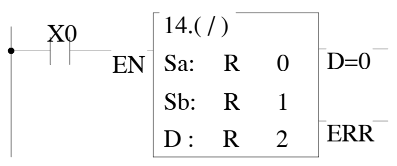
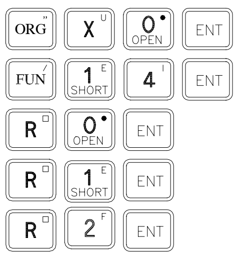
| Range / Operand | WX | WY | WM | WS | TMR | CTR | HR | IR | OR | SR | ROR | DR | K | XR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | WX0 ∣ WX240 | WY0 ∣ WY240 | WM0 ∣ WM1896 | WS0 ∣ WS984 | T0 ∣ T255 | C0 ∣ C255 | R0 ∣ R3839 | R3840 ∣ R3903 | R3904 ∣ R3967 | R3968 ∣ R4167 | R5000 ∣ R8071 | D0 ∣ D3071 | 16/32-bit +/– number | V 、 Z |
| Sa | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Sb | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| D | | ○ | ○ | ○ | ○ | ○ | ○ | | ○ | ○* | ○* | ○ | | ○ |

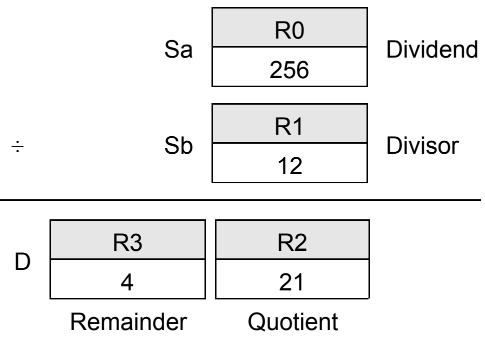
## Description

● Performs the division of the data specified at Sa and Sb and writes the quotient and remainder to registers specified by register D when the division control input "EN" =1 or "EN↑" (**P** instruction) from 0 to 1. If the quotient of division is equal to 0 then set FO0 to 1. If the divisor Sb=0 then set the error flag FO1 to 1 without executing the instruction.

## Example 1

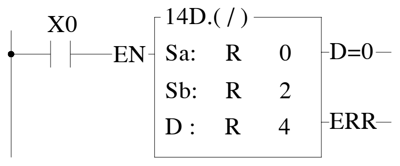
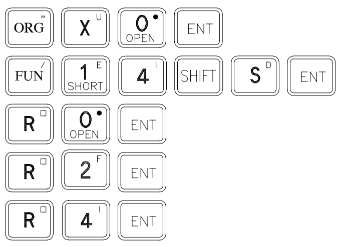
16-bit division

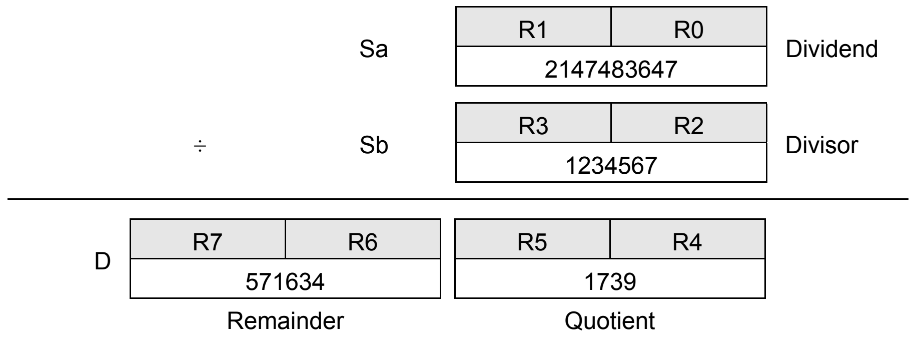
| Ladder Diagram | Key Operations | Mnemonic Codes |
|---|---|---|
|  |  | ORG X 0<br>FUN 14<br>Sa : R 0<br>Sb : R 1<br>D : R 2 |



| FUN 14 D P (／) | DIVISION (Performs division of the data specified at Sa and Sb and stores the result in D) | FUN 14 D P (／) |
|---|---|---|

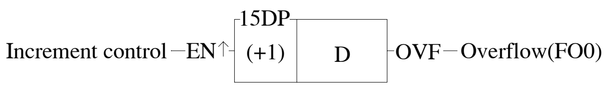
**Example 2** 32-bit division

| Ladder Diagram | Key Operations | Mnemonic Codes |
|---|---|---|
|  |  | ORG X 0<br>FUN 14D<br>Sa : R 0<br>Sb : R 2<br>D : R 4 |



| FUN 15 D P (+1) | INCREMENT (Adds 1 to the D value) | FUN 15 D P (+1) |
|---|---|---|

Ladder symbol



Operand

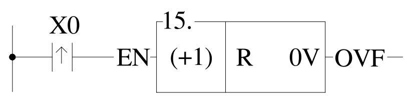
D : The register to be increased

D may combine with V, Z to serve indirect addressing

| Range / Operand | WY | WM | WS | TMR | CTR | HR | OR | HR | HSCR | RTCR | SR | ROR | DR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | WY0 \| WY240 | WM0 \| WM1896 | WS0 \| WS984 | T0 \| T255 | C0 \| C255 | R0 \| R3839 | R3904 \| R3919 | R3920 \| R4047 | R4096 \| R4127 | R4128 \| R4135 | R4136 \| R4167 | R5000 \| R8071 | D0 \| D3071 |
| D | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○* | ○* | ○ |

- Adds 1 to the register D when the increment control input "EN" =1 or "EN↑" (P instruction) from 0 to 1. If the value of D is already at the upper limit of positive number 32767 or 2147483647, adding one to this value will change it to the lower limit of negative number -32768 or -2147483648. At the same time, the overflow flag FO0 (OVF) is set to 1.

Example 16-bit increment register

| Ladder diagram | Key operations | Mnemonic code |
|---|---|---|
|  | ORG TU X 0 ENT / FUN 1 5 ENT / R 0 SHIFT T ENT | ORG TU X 0<br>FUN 15<br>D : R 0V |

When V＝100，0＋100＝100

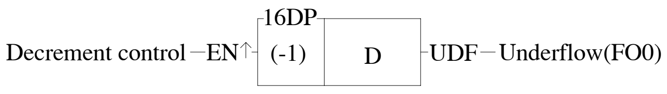
| | | |
|---|---|---|
| D | R100 | 1 |

⇩X0＝↑

| | | |
|---|---|---|
| D | R100 | 2 |

| FUN 16 D P (−1) | DECREMENT (Subtracts 1 from the D value) | FUN 16 D P (−1) |
|---|---|---|

Ladder symbol



Operand

D : The register to be decreased
D may combine with V, Z to serve indirect addressing

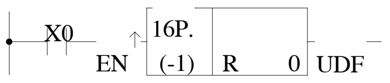
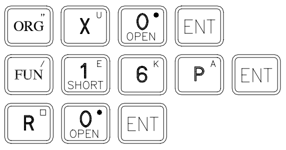
| Range / Ope-rand | WY | WM | WS | TMR | CTR | HR | OR | HR | HSCR | RTCR | SR | ROR | DR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | WY0 ｜ WY240 | WM0 ｜ WM1896 | WS0 ｜ WS984 | T0 ｜ T255 | C0 ｜ C255 | R0 ｜ R3839 | R3904 ｜ R3919 | R3920 ｜ R4047 | R4096 ｜ R4127 | R4128 ｜ R4135 | R4136 ｜ R4167 | R5000 ｜ R8071 | D0 ｜ D3071 |
| D | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○* | ○* | ○ |

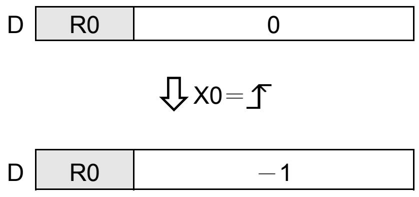
## Description

● Subtracts 1 from the register D when the decrement control input "EN" =1 or "EN ↑ " (P instruction) from 0 to 1. If the value of D is already at the lower limit of negative number -32768 or -2147483648, subtracting one from this value will change it to the upper limit of positive number 32767 or 2147483647. At the same time, the underflow flag FO0 (UDF) is set to 1.

## Example

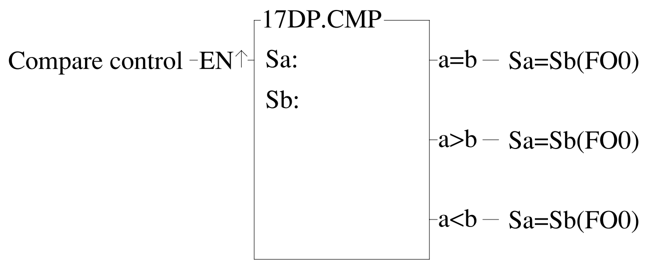
16-bit decrement register

| Ladder diagram | Key operations | Mnemonic code |
|---|---|---|
|  |  | ORG X 0<br>FUN 16P<br>D : R 0 |



| FUN 17 D P<br>CMP | COMPARE<br>(Compares the data of Sa and Sb and outputs the results to function Outputs) | FUN 17 D P<br>CMP |
|---|---|---|

Ladder symbol



Operand

Sa: The register to be compared

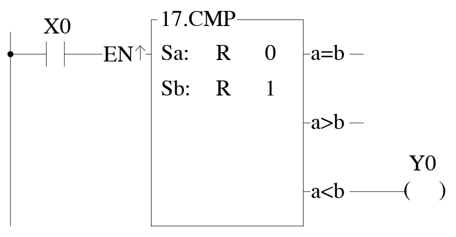
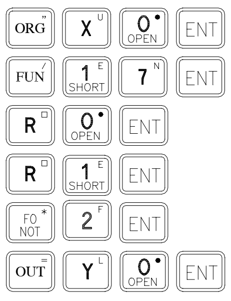
Sb: The register to be compared

Sa, Sb may combine with V, Z to serve indirect addressing

| Range / Ope-rand | WX | WY | WM | WS | TMR | CTR | HR | IR | OR | HR | HSCR | RTCR | SR | ROR | DR | K |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | WX0<br>\|<br>WX240 | WY0<br>\|<br>WY240 | WM0<br>\|<br>WM1896 | WS0<br>\|<br>WS984 | T0<br>\|<br>T255 | C0<br>\|<br>C255 | R0<br>\|<br>R3839 | R3804<br>\|<br>R3903 | R3904<br>\|<br>R3919 | R3920<br>\|<br>R4047 | R4096<br>\|<br>R4127 | R4128<br>\|<br>R4135 | R4136<br>\|<br>R4167 | R5000<br>\|<br>R8071 | D0<br>\|<br>D3071 | 16/32 bit<br>+/-number |
| Sa | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Sb | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

- Compares the data of Sa and Sb when the compare control input "EN" =1 or "EN ↑ " (P instruction) from 0 to 1. If the data of Sa is equal to Sb, then set FO0 to 1. If the data of Sa>Sb, then set FO1 to 1. If the data of Sa<Sb, then set FO2 to 1. If the data of Sa < Sb, then set the FO2 to 1.

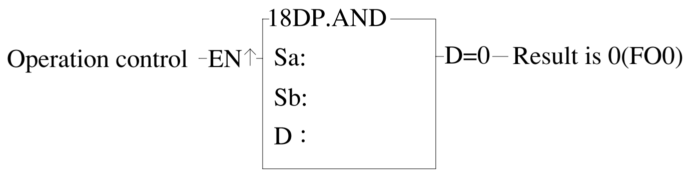
**Example** Compares the data of 16-bit register

| Ladder diagram | Key operations | Mnemonic code |
|---|---|---|
|   X0<br>EN↑<br>17.CMP<br>Sa: R 0<br>Sb: R 1<br>a=b<br>a>b<br>a<b<br>Y0 |   ORG X 0 ENT<br>FUN 1 7 ENT<br>R 0 ENT<br>R 1 ENT<br>FO NOT 2 ENT<br>OUT Y 0 ENT | ORG X 0<br>FUN 17<br>Sa : R 0<br>Sb : R 1<br>FO 2<br>OUT Y 0 |

- From the above example, we first assume the data of R0 is 1 and R1 is 2, and then compare the data by executing the CMP instruction. The FO0 and FO1 are set to 0 and FO2 (a<b) is set to 1 since a<b.
- If you want to have the compound results, such as≧、≦、< > etc., please send =、< and > results to relay first and then combine the result from the relays.
- M1919=0, when this command in not executed, FO0, FO1, FO2 will remain in the status at last execution.
- M1919=1, when this command in not executed, FO0, FO1, FO2 are all cleared to 0.
- Control M1919 properly to obtain memory-holding function for functional command output.

| FUN 18 D P AND | LOGICAL AND | FUN 18 D P AND |
|---|---|---|

## Ladder symbol



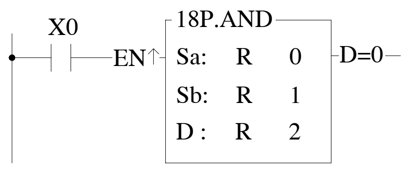
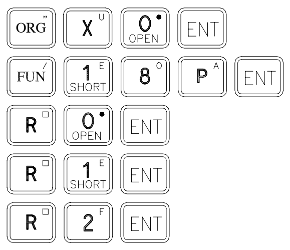
## Operand

Sa: The register to be ANDed
Sb: The register to be ANDed
D : The register to store the result of AND
The Sa, Sb, D may combine with V, Z to serve indirect addressing application

| Range / Ope-rand | WX | WY | WM | WS | TMR | CTR | HR | IR | OR | HR | HSCR | RTCR | SR | ROR | DR | K |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | WX0 \| WX240 | WY0 \| WY240 | WM0 \| WM1896 | WS0 \| WS984 | T0 \| T255 | C0 \| C255 | R0 \| R3839 | R3804 \| R3903 | R3904 \| R3919 | R3920 \| R4047 | R4096 \| R4127 | R4128 \| R4135 | R4136 \| R4167 | R5000 \| R8071 | D0 \| D3071 | 16/32 bit +/-number |
| Sa | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Sb | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| D | | ○ | ○ | ○ | ○ | ○ | ○ | | ○ | ○ | ○ | ○ | ○* | ○* | ○ | |

- Performs logical AND operation for the data of Sa and Sb when the operation control input "EN" =1 or "EN ↑ " ( P instruction) from 0 to 1. This operation compares the corresponding bits of Sa and Sb (B0~B15 or B0~B31). The bit in the D is set to 1 if both of the corresponding bits data of Sa and Sb is 1. The bit in the D is set to 0 if one of the corresponding bits is 0.

**Example** Operation of 16-bit logical AND

| Ladder diagram | Key operations | Mnemonic code |
|---|---|---|
|  |  | ORG X 0<br>FUN 18P<br>Sa : R 0<br>Sb : R 1<br>D : R 2 |

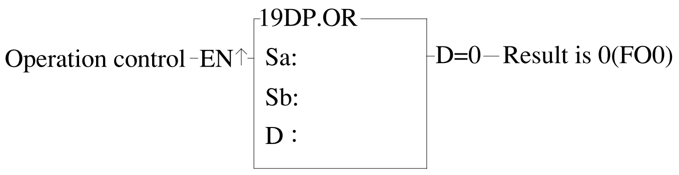
| | | B15 | | | | | | | | | | | | | | | B0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sa | R0 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 |
| Sb | R1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 0 |

⇩ X0 = ↑

| | | B15 | | | | | | | | | | | | | | | B0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| D | R2 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 |

| FUN 19 D P<br>OR | LOGICAL OR | FUN 19 D P<br>OR |
|---|---|---|

Ladder symbol



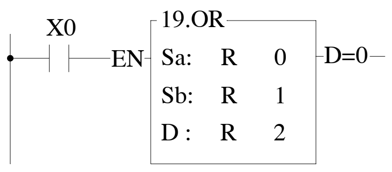
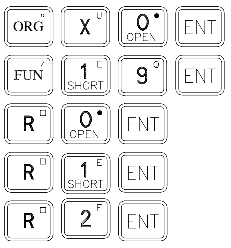
Operand

Sa: The register to be ORed
Sb: The register to be ORed
D : The register to store the result of OR
The Sa, Sb, D may combine with V, Z to serve indirect addressing

| Range / Operand | WX | WY | WM | WS | TMR | CTR | HR | IR | OR | HR | HSCR | RTCR | SR | ROR | DR | K |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | WX0<br>\|<br>WX240 | WY0<br>\|<br>WY240 | WM0<br>\|<br>WM1896 | WS0<br>\|<br>WS984 | T0<br>\|<br>T255 | C0<br>\|<br>C255 | R0<br>\|<br>R3839 | R3804<br>\|<br>R3903 | R3904<br>\|<br>R3919 | R3920<br>\|<br>R4047 | R4096<br>\|<br>R4127 | R4128<br>\|<br>R4135 | R4136<br>\|<br>R4167 | R5000<br>\|<br>R8071 | D0<br>\|<br>D3071 | 16/32 bit<br>+/-number |
| Sa | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | | ○ | ○ | ○ | ○ | ○ | ○ |
| Sb | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | | ○ | ○ | ○ | ○ | ○ | ○ |
| D | | ○ | ○ | ○ | ○ | ○ | ○ | | ○ | | ○ | ○ | ○* | ○* | ○ | |

● Performs logical OR operation for the data of Sa and Sb when the operation control input "EN" =1 or "EN ↑ " (P instruction) from 0 to 1. This operation compares the corresponding bits of Sa and Sb (B0~B15 or B0~B31). The bit in the D is set to 1 if one of the corresponding of Sa or Sb is 1. The bit in the D is set to 0 if both of the corresponding bits of Sa and Sb is 0.

**Example** Operation of 16-bit logical OR

| Ladder diagram | Key operations | Mnemonic code |
|---|---|---|
|  |  | ORG X 0<br>FUN 19<br>Sa : R 0<br>Sb : R 1<br>D : R 2 |

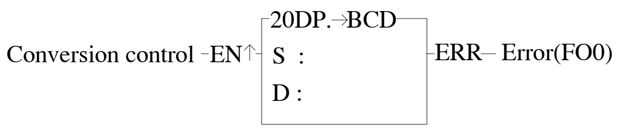
| | | B15 | | | | | | | | | | | | | | | B0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sa | R0 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 1 |
| Sb | R1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 0 |

⇩ X0＝1

| | | B15 | | | | | | | | | | | | | | | B0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| D | R2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 |

| FUN 20 DP →BCD | BIN TO BCD CONVERSION (Converts BIN data of the device specified at S into BCD and stores the result in D) | FUN 20 DP →BCD |
|---|---|---|

## Ladder symbol



## Operand

S : The register to be converted

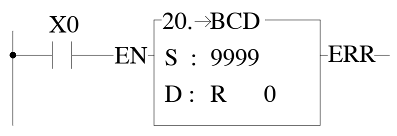
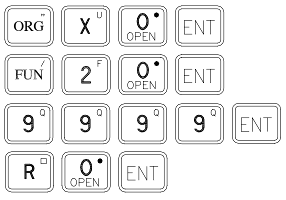
D : The register to store the converted data (BCD code)

The S, D may combine with V, Z to serve indirect addressing

| Range / Operand | WX | WY | WM | WS | TMR | CTR | HR | IR | OR | HR | HSCR | RTCR | SR | ROR | DR | K |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | WX0 ∣ WX240 | WY0 ∣ WY240 | WM0 ∣ WM1896 | WS0 ∣ WS984 | T0 ∣ T255 | C0 ∣ C255 | R0 ∣ R3839 | R3804 ∣ R3903 | R3940 ∣ R3919 | R3920 ∣ R4047 | R4096 ∣ R4127 | R4128 ∣ R4135 | R4136 ∣ R4167 | R5000 ∣ R8071 | D0 ∣ D3071 | 16/32 bit +/- number |
| S | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| D | | ○ | ○ | ○ | ○ | ○ | ○ | | ○ | ○ | ○ | ○ | ○* | ○* | ○ | |

- FB-PLC uses binary code to store and to execute calculations. If want to send the internal PLC data to the external displays such as seven-segment displays, it is more convenient for us to read the result on screen by converting the BIN data to BCD data. For example, it is more clear for us to read the reading "12" instead of the binary code "1100."
- Converts BIN data of the device specified at S into BCD and writes the result in D when the operation control input "EN" =1 or "EN ↑ " (P instruction) from 0 to 1. If the data in S is not a BCD value (0~9999 or 0~9999999), then the error flag FO0 is set to 1 and the old data of D are retained.

**Example** 16-bit BIN to BCD conversion

| Ladder diagram | Key operations | Mnemonic code |
|---|---|---|
|  |  | ORG X 0<br>FUN 20<br>S : 9999<br>D : R 0 |

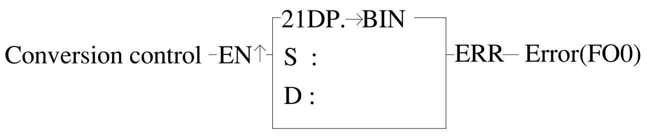
| | | B15 | | | | | | | | | | | | | | | B0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S | K | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |

⇩X0＝1

| | | B15 | | | | | | | | | | | | | | | B0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| D | R0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 |

| FUN 21 D P →BIN | BCD TO BIN CONVERSION (Converts BCD data of the device specified at S into BIN and stores the result in D) | FUN 21 D P →BIN |
|---|---|---|

**Ladder symbol**



**Operand**

S : The register to be converted

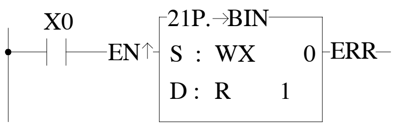
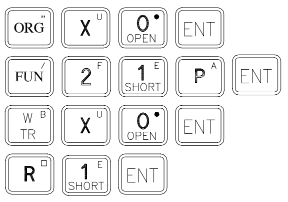
D : The register to store the converted data (BIN code)

The S, D may combine with V, Z to serve indirect addressing

| Range / Operand | WX | WY | WM | WS | TMR | CTR | HR | IR | OR | HR | HSCR | RTCR | SR | ROR | DR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | WX0 \| WX240 | WY0 \| WY240 | WM0 \| WM1896 | WS0 \| WS984 | T0 \| T255 | C0 \| C255 | R0 \| R3839 | R3840 \| R3903 | R3904 \| R3919 | R3920 \| R4047 | R4096 \| R4127 | R4128 \| R4135 | R4136 \| R4167 | R5000 \| R8071 | D0 \| D3071 |
| S | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| D | | ○ | ○ | ○ | ○ | ○ | ○ | | ○ | ○ | ○ | ○ | ○* | ○* | ○ |

- The decimal (BCD) data must be converted to binary (BIN) data first in order for PLC to accept the data which is originally in decimal unit (BCD code) inputted from external device such as digital switch because the BCD data can not be accepted by PLC for its operations.
- Converts BCD data of the device specified at S into BIN and writes the result in D when the operation control input "EN" =1 or "EN ↑ " (P instruction) from 0 to 1. If the data in S is not in BCD, then the error flag FO0 is set to 1 and the old data of D are retained.
- Constant is converted to BIN automatically when store in program and can not be used as a source operand of this function.

**Example** 16-bit BCD to BIN conversion

| Ladder diagram | Key operations | Mnemonic code |
|---|---|---|
|  |  | ORG X 0<br>FUN 21P<br>S : WX 0<br>D : R 1 |

X15 ↓ (1, 2, 3, 4) ↓ X0

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S | WX0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 |

⇩ X0 = ↑

B15 ↓ ↓ B0

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| D | R1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 0 |